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A Survey on Customer Needs with Regard to an Innovative Business Model:

Time-Delayed Charging of Electric Cars with Green Electricity Self-Produced at Home

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Summary

The competence center for innovative business models, under leadership of Prof. Dr. Anna Nagl, – together with the distribution system operator Überlandzentrale Wörth/I.-Altheim Netz AG (ÜZW) and bozem | consulting associates | munich – researches and develops new business models for sustainable electromobility. To reach an ideal customer acceptance, all stakeholders participate in the development process. In addition to a written survey of all ÜZW customers using an own photovoltaic system, design thinking workshops and an open innovation platform are used to involve the stakeholders. This paper presents the business model "time-delayed charging of electric cars with green electricity self-produced at home".

Keywords: innovative business models, economic resilience, low-carbon city, electric vehicles, renewable and sustainable energy

1 Background

The competence center for innovative business models at Aalen University, under leadership of Prof. Dr. Anna Nagl, researches new business models for future-oriented electromobility, inter alia, ecological possibilities to charge electric vehicles with solar power. The project is state subsidized by the

Bundesministerium für Bildung und Forschung (BMBF, i.e. German Federal Ministry of Education and Research). The research is conducted together with Überlandzentrale Wörth/I.-Altheim Netz AG (ÜZW), the regional distribution system operator. Bozem | consulting associates | munich supports the project with expertise in renewable energy and competitive strategy.

Electric vehicles provide new business areas for energy companies and give them the chance to strengthen their market position with innovative business models. Only when the needs of the stakeholders are brought together within one business model, there is an added value.

To locate the customer needs, the project team generated a hypotheses-based questionnaire needed to develop an economically resilient business model. The survey was sent to all 1,305 customers of the distribution system operator ÜZW who use an own photovoltaic (PV) system. Furthermore, design thinking workshops and an open innovation platform were used to integrate all stakeholders in the research project.

The results were evaluated by the project team. Based on these results, the project team derived concepts for innovative business models. The following paper presents the research and implementation results of the exemplary business model "time-delayed charging of electric cars with green electricity self-produced at home".

2 Drivers for Innovative Business Models in the Energy Sector

Apart from other trends such as big data and digitization, the energy turnaround has a strong impact on the changes in the electricity market. This impact happens through the increasing portion of renewable energies and the rising energy efficiency. The ongoing change offers the opportunity for new business models in this market. To succeed in this market, the traditional structures of "mere" electricity sales have to be broken up and innovative business models have to be established. This is the only way for suppliers on the market to be successful in the long term.

Electricity sales from public energy grids will decrease sooner or later because of the increasing self-consumption of PV power producers, especially when the systems fall out of the German Renewable Energies Act (EEG) [1], and the growing number of decentralized PV system installations.

With the coming into force of the first EEG in March 2000, all PV systems installed before the year 2000 were assured EEG remuneration for a period of 20 years. The year of initial operation for these PV systems is determined to be 2000. Therefore, arithmetically, the remuneration period of 20 years starts from 2001. As a result, PV systems will first fall out of EEG remuneration on December 31, 2020.

Battery storage devices, which become more and more economical, will accelerate the development of decreasing electricity sales from public energy grids. If well-established electric companies do not find solutions to these developments with innovative business models, they will soon face lower electricity sales and lower profitability.

It can already be observed that more and more electric companies do not want to be pure suppliers of electricity any more, but they adopt more and more the role of energy service providers. These energy services include simple consultancy on energy saving, energy consultancy for residential buildings, issuance of energy certificates, heating contracting, thermography of PV systems or the consultancy for and installation of charging stations. Furthermore, a rising number of start-up companies as additional competitors penetrates certain stages of the value chain.

The electromobility offers energy companies new business areas and potential since the electromobility market is predicted to grow [2]. This is especially reinforced by the political will of the Federal Government to sustainably decrease carbon dioxide emissions and fine dust, the "dieselgate" [3] and the increasing supply of electric vehicles from automotive manufacturers. Companies strengthening their market position through innovative and economically resilient business models and creating and securing advantages over competitors at an early stage will profit from the growing electromobility market.

Customer acquisition and retention allows to sell larger amounts of energy in the long term. This can counteract the sales reduction through the personal use of PV power. For the establishment of electromobility on the market, energy companies have to research and develop new business models. New competitors (e.g.

car dealerships, mobility providers etc.), who directly offer electricity in addition to the electric vehicle, and start-up companies, who occupy the customer interface, emerge [4, 5].

3 Business Model „Time-Delayed Charging of Electric Cars with Green Electricity Self-Produced at Home“

3.1 Methodology

The business model “time-delayed charging of electric cars with green electricity self-produced at home” was developed in the cooperative BMBF project “CO_2-arme Stadt” (“low-carbon city”) by means of a design thinking workshop [6] together with ÜZW and bozem | consulting associates | munich.

The ideas for business models that emerged in the workshop were elaborated, extended, refined and iteratively adjusted with the business model builder (Fig. 1) designed by Prof. Dr. Anna Nagl and Dr. Karlheinz Bozem. As a next step, the BMBF project partner ÜZW tested the generated ideas for business models in practice and conducted prototyping.

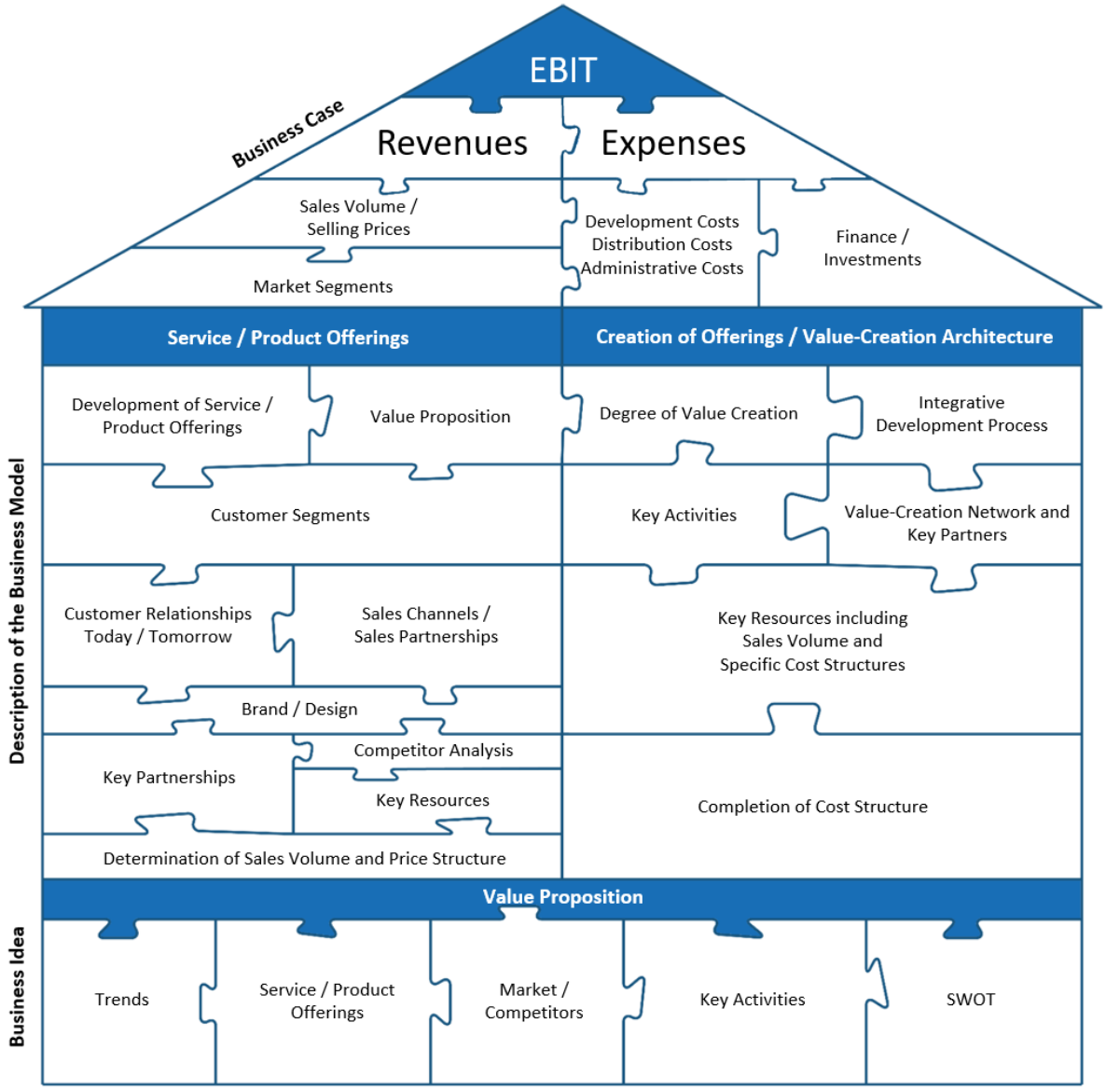

Figure 1: Business model builder [5]

To ensure that the business models conceptualized in the design thinking workshop are tailored toward meeting the customer needs and expectations, an empirical study was conducted prior to the pilot testing consulting all ÜZW customers who use an own PV system. In this written survey, 1,305 households, farmers, industrial and commercial companies as well as municipalities were contacted with a questionnaire, individually adapted to each customer group and hypothesis-based. The response rate of the empirical study in the grid territory of ÜZW was 22.2 %, i.e. 290 completed questionnaires, a response rate significantly higher than that of comparable customer surveys.

3.2 Development and Realization Process of the Business Model

In the development of the business model "time-delayed charging of electric cars with green electricity self-produced at home", the research and development project team followed a process with external and internal monitoring detailed in Fig. 2. The external monitoring was enabled by an open innovation platform. The internal monitoring was conducted through the internal controlling of the BMBF project partners.

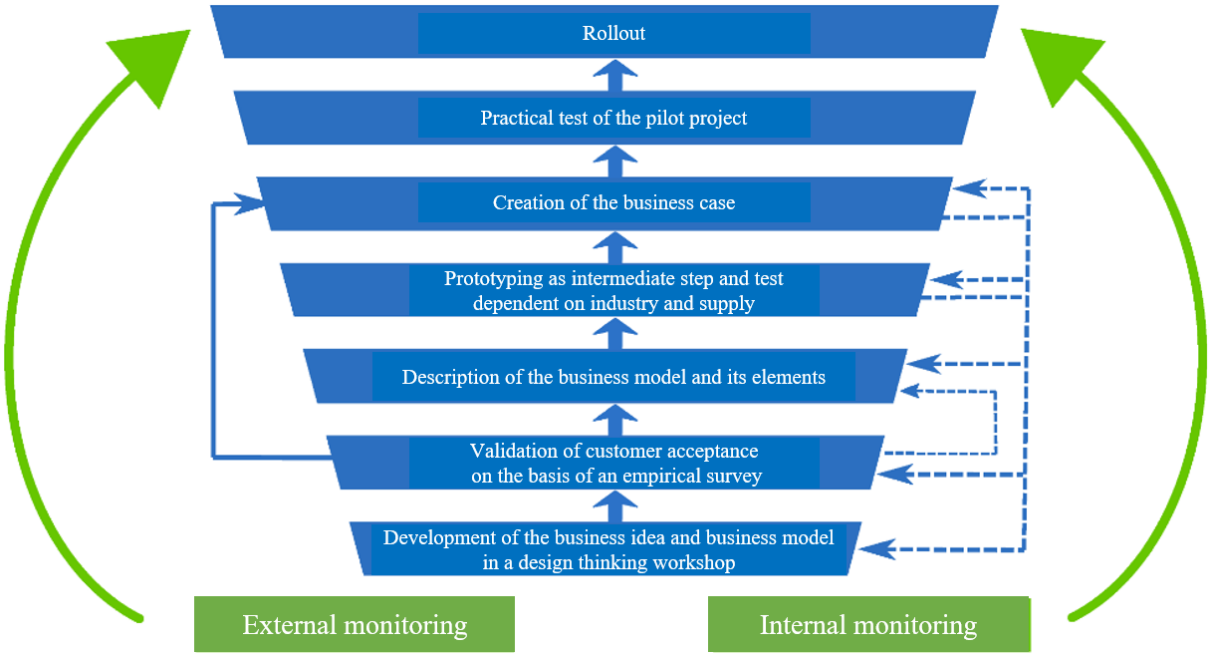

Figure 2: Development and realization process of business models

The business ideas and business models were developed in design thinking workshops. This way, the research team ensured that the emphasis was not solely put on the pure development process. Instead, the research team paid attention to include the customer perspective in the development process in order to meet customer needs and wishes in the final business model. Fig. 3 shows the phases of the design thinking process applied.

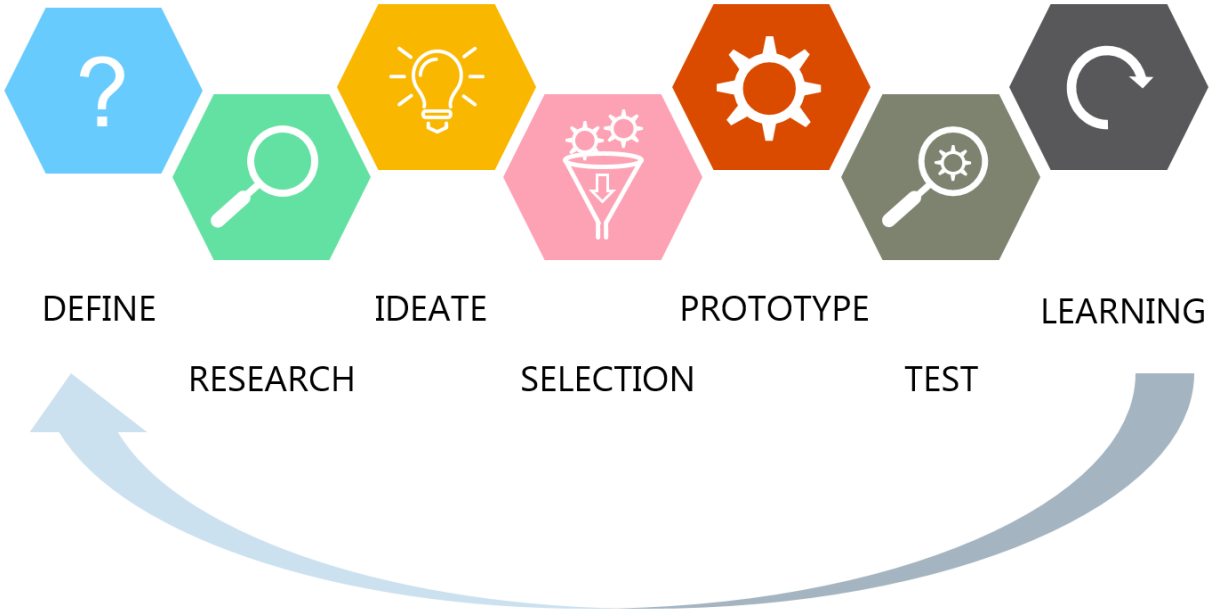

Figure 3: Design thinking process

In a first step, the *"define"* phase took place in cooperation with ÜZW to define expectations, emotions and personal situations of potential customers. The team identified how a new offer of ÜZW ought to look like to meet changing market conditions and regulations as well as to cope with challenges, while being beneficial for both parties. In the further course of the workshop, the goal was to develop a business model for the business idea "charging of electric cars with green electricity self-produced at home: during PV power generation and time-delayed" (Fig. 4).

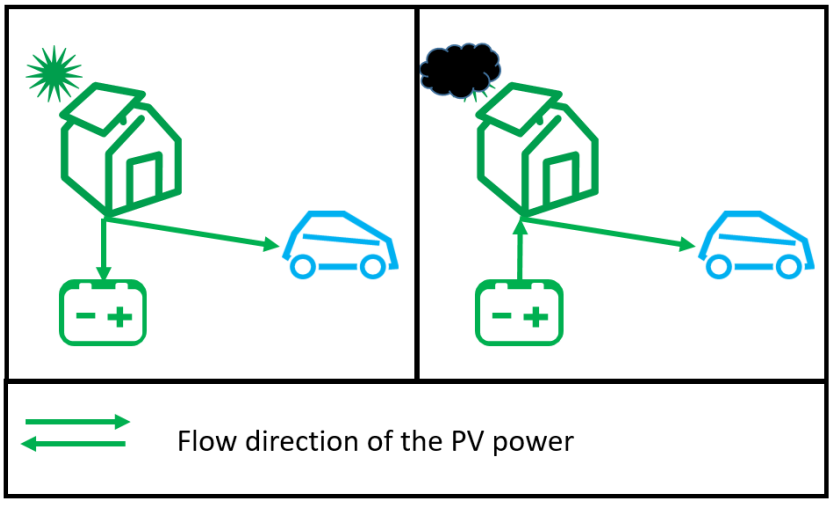

Figure 4: Schematic illustration of the charging procedure

The *"research"* phase followed as a next step. The basic findings and insights were analyzed, interpreted and structured to lay the foundation for the development of the business model. Using a questionnaire for the survey with potential customers, a "persona" was identified and potential ideas that could be part of the product were tested for customer acceptance and preferences. In user-centric design, a "persona" is a fictional character created to represent a specific user type with a bundle of attributes. This analysis of customer needs allowed to derive detailed explicit and implicit needs of potential customers. Then, a comprehensive state-

of-the-art analysis concerning the previously defined business idea was conducted to ensure that the basic idea is feasible from both the technological and the legislative point of view. Furthermore, the state-of-the-art analysis secured that duplication of work is avoided which could have been the case when the same or a similar idea would already have been in implementation somewhere else.

Consequently, the *"ideate"* phase was used for brainstorming based on the previously gathered findings. The aim was to generate ideas and solutions for potential customers and elaborate the business model. Moreover, all stakeholders (e.g. customers, project partners, scientists and experts) were integrated in the further development of the business model through an open innovation platform.

In the *"selection"* phase, all collected ideas were condensed, evaluated and filtered. In the selection process, the research team attached importance to ideas that are innovative on the one hand, but realizable on the other hand. The prototype derived in the *"prototype"* phase included the business idea, the business model and the business case. With the prototype, the basic idea could be demonstrated to potential customers for the first time. Subsequently, the prototype served as a fundament for further customer advisory service. Providing customer advice aimed at receiving insights about the interest of potential customers and identifying points where there is room for improvement. The practical implementation took place in the *"test"* phase. The business model was tested in practice as a pilot project. This phase served as a source of valuable knowledge for the *"learning"* phase. Grounded on this feedback, the business model was iteratively refined in multiple steps.

3.3 Results of the Customer Survey

When developing the business model „time-delayed charging of electric cars with green electricity self-produced at home", inter alia, the survey results presented in the following were considered: Regarding the household customers with a PV system, 96.8 % show a high willingness to use own PV power to charge their electric car (Fig. 5).

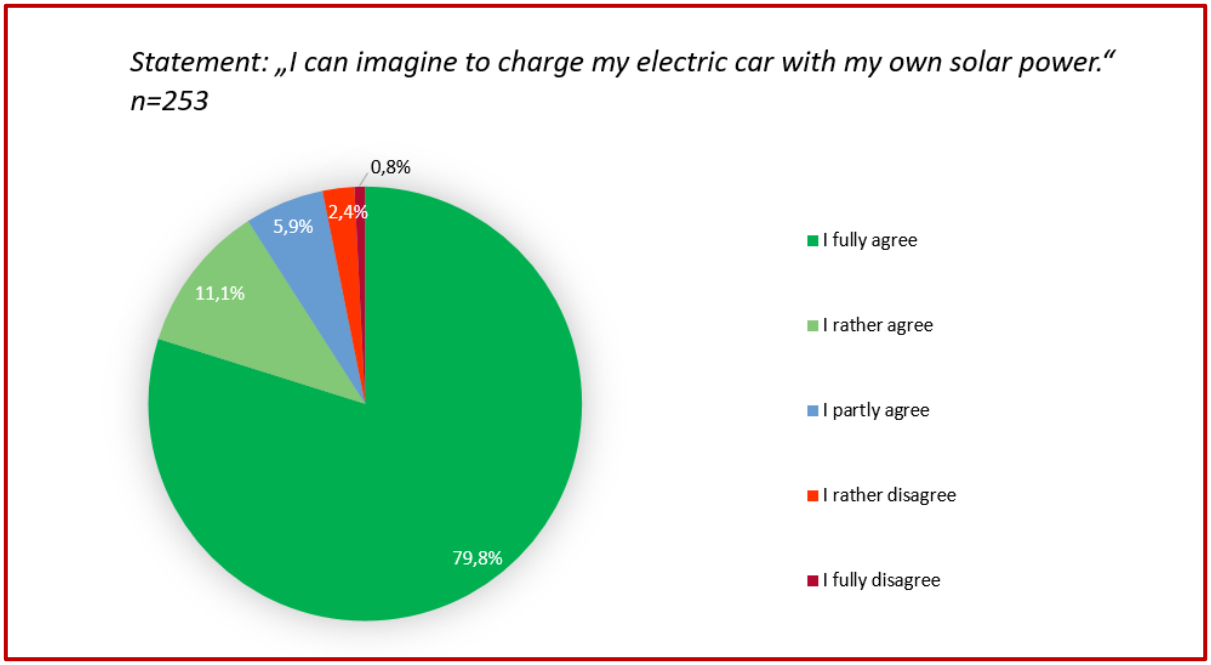

Figure 5: Charging willingness with own solar power

Against this background, it is crucial to understand the reasons why there is no observable increased interest from the consumer so far in the combination of energy storage and electromobility. Fig. 6 reveals that high acquisition costs constitute the strongest barrier from the customer perspective. Technical aspects such as lifetime and battery range or the risk that the technology could be obsolete are further reasons. These insights are essential for the development of the business models since reservations like this from the customers can be addressed and at least partially be removed though an extensive and qualified consultancy.

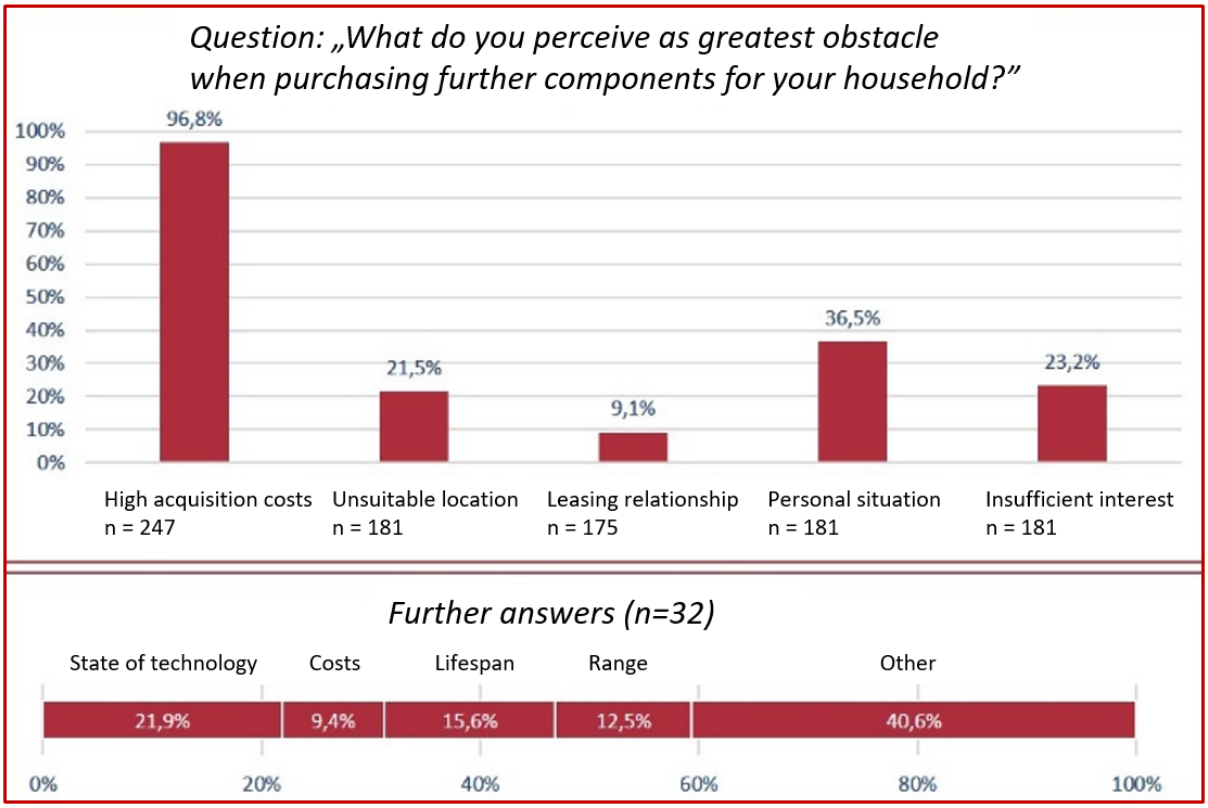

Figure 6: Acquisition barriers

With regards to the preferred charging location of the respondents, charging at home is given highest priority from the ÜZW customers. In this context, the respondents wish to access inexpensive electricity overnight with an own energy storage in the basement, increasing the own consumption of PV power (Fig. 7). With that in mind, the greatest focus in the BMBF cooperative project was placed on the business model time-delayed charging with own PV power at home. Since the respondents also showed strong interest in charging e.g. during work at the employer, future-oriented and economically resilient business models are developed and tested in practice for different charging locations and charging times in the further course of the project.

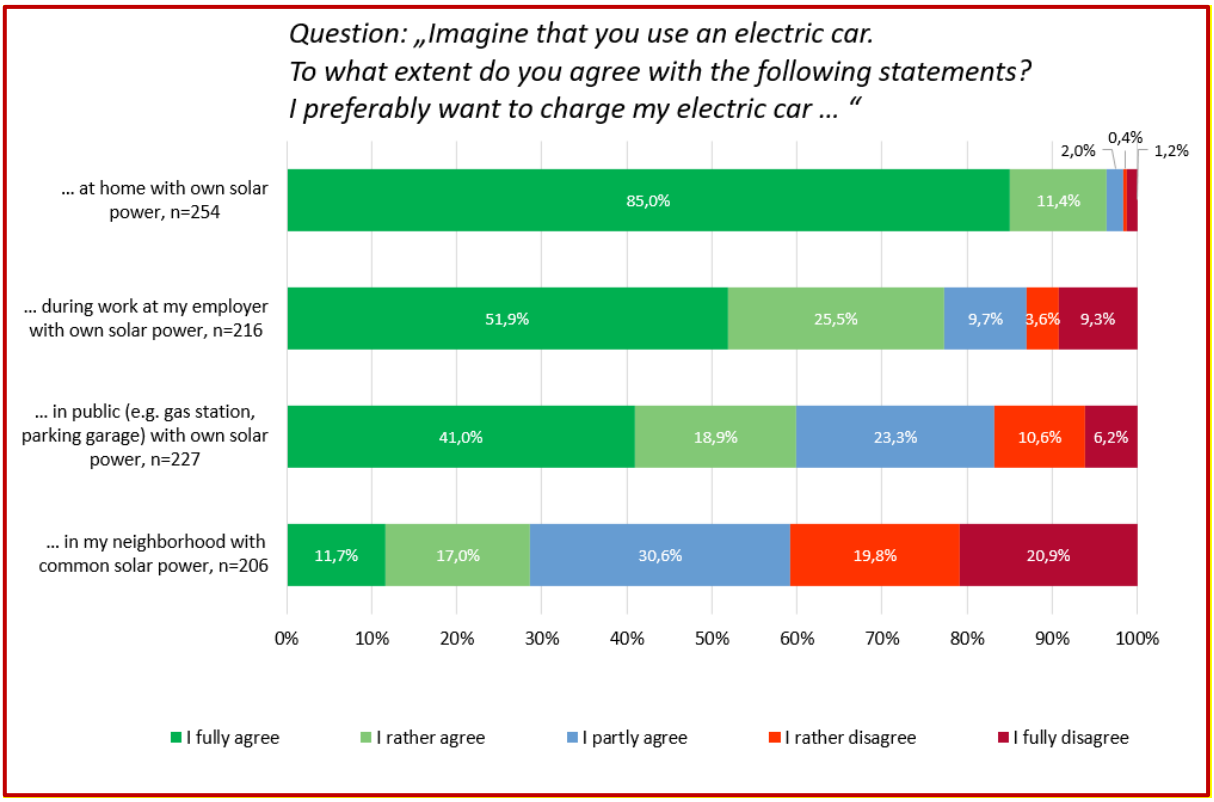

Figure 7: Preferred charging place

3.4 Open Innovation Method

To actively involve all stakeholders in the further development and optimization of the business models, the business models were published on a so called open innovation platform. An open innovation platform is an online-based tool which offers stakeholders the opportunity to actively participate in the development of new business models. The ÜZW customers did not know the open innovation method in the beginning. Hence, during the construction and the start of the platform, special attention was paid to briefly and precisely communicate the purpose of the open innovation platform to the users as well as the expectations towards them.

An open innovation platform can be constructed in diverse ways: If access is provided to the general public without any restrictions, a platform like this can be used generate ideas. An example can be found with “eMobilisten” [7]. Every user registered can see all entries submitted, leave comments and submit their own entries. Moreover, there is the possibility to use an open innovation platform for the solution of specific questions and problems, as it is the case with e.g. Bosch Power Tools [8]. In this case, users cannot access third-party postings or make use of the comments function. To provide another example, the sports equipment fair “ISPO” uses their open innovation platform in a different way [9]. In that case, a preceding questionnaire selects testers who match various innovative projects.

In the context of the BMBF cooperative project “low-carbon city”, all stakeholders registered on the open innovation platform can insert their ideas for the research project [10]. All platform users are asked to comment and evaluate ideas and business models. Thus, customer requirements can be integrated into the complete development process of the business models to ensure a customer-oriented development (Fig. 8). The possibility to display ideas and business models according to their status, e.g. “under development” or “under implementation”, allows to keep the users of the open innovation platform informed about the status quo.

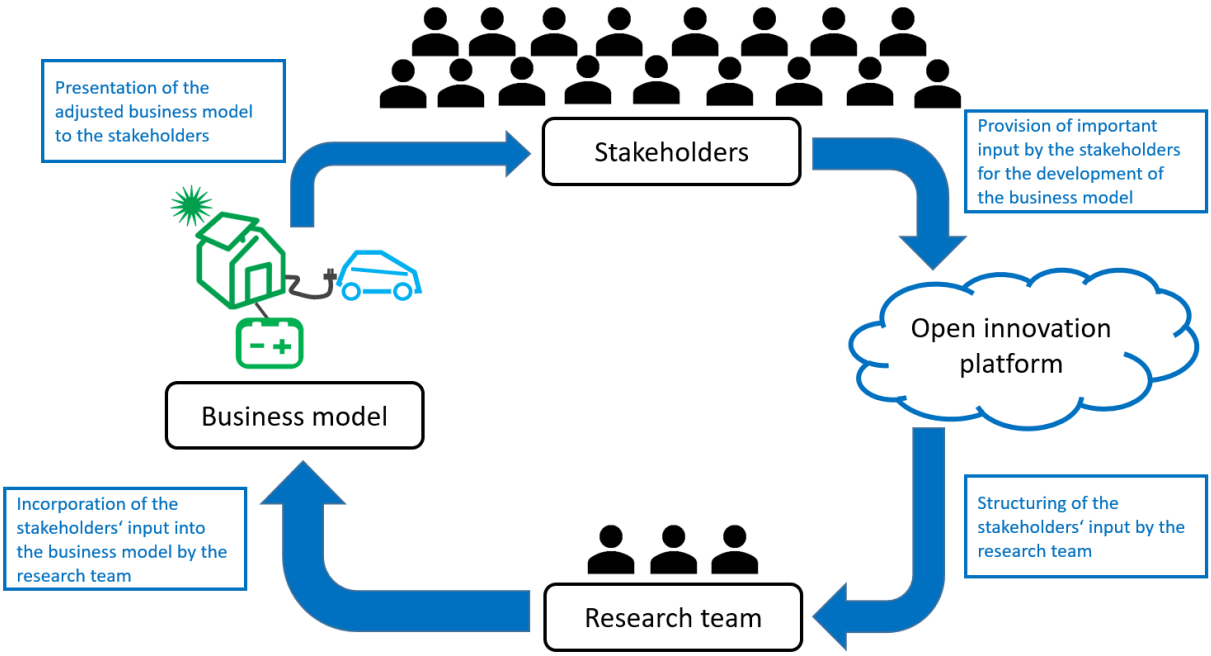

Figure 8: Integration of the stakeholders' input into the development process of the business model

3.5 Pilot Project

Out of five business models to be developed within the BMBF cooperative project, the business model "time-delayed charging of electric cars with green electricity self-produced at home" was first tested in practice by ÜZW as a pilot project. For this purpose, ÜZW let local craft businesses install two PV systems at the facility site. These systems were connected to a battery storage device, a charging station and an energy management system (Fig. 9). The results and insights gained from the pilot project served as a source of improvement potential for the business model.

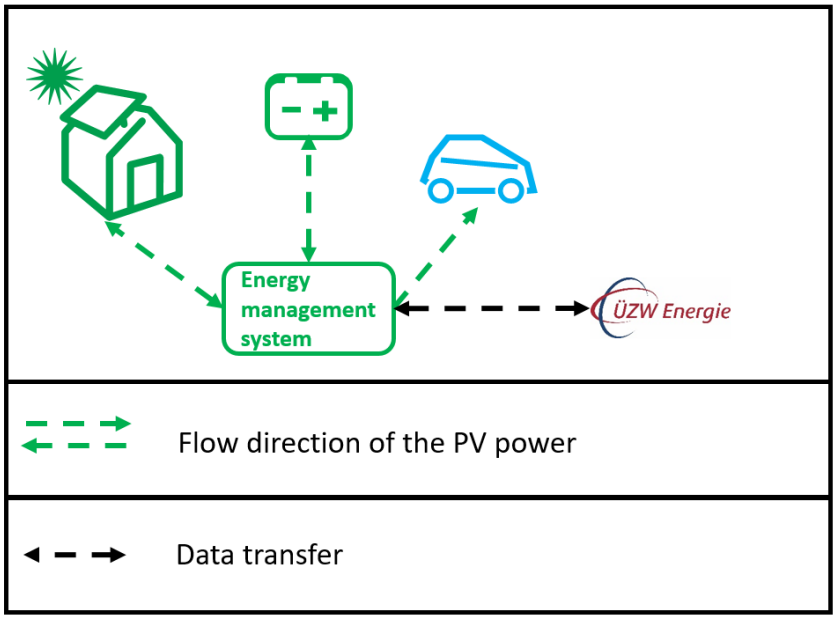

Figure 9: Schematic structure of the pilot project

Based on the research findings from other research projects, the results from the own design thinking workshop, the customer survey, the open innovation platform and the practical testing, an economically resilient and sustainable business case [11] was elaborated for the business model “time-delayed charging of electric cars with green electricity self-produced at home”.

In this business model, ÜZW takes over the sales as well as the installation and service of the complete system consisting of PV system, battery storage, charging station, energy management system and smart meter. The unique selling proposition of this business model is the position of ÜZW as exclusive contact for all aspects of the energy supply, the regional ties to the partner companies and the close customer relationship as regional electricity supplier. Competent advice can be provided thanks to the experience gained from the pilot project on the company site. Moreover, the purchase of a battery storage device causes customers to strongly trust in such a system.

The partnership with local craft businesses leads to a positive image in terms of promoting the local economy and enhancing flexible and prompt customer service in case of problems and maintenance due to the geographical proximity.

4 Conclusion

In this BMBF cooperative project, a business model was developed for “time-delayed charging of electric cars with green electricity self-produced at home”. This business model can continuously be adapted to changing market conditions and regulations as well as to wishes and needs of the customer. Accordingly, several ideas for potential extensions of the business model came up already during the development of the basic business model, e.g. to provide an all-round carefree package in addition to the complete system where all maintenance and service work is covered by a flat-rate fee.

The business models for the supplemental charging locations requested by the ÜZW customers will be developed in a next step with the same methodology and tested in practice with pilot projects. That way, further business models based on service innovations for electromobility will be researched, tested and implemented in the context of the BMBF cooperative project “low-carbon city”.

The customer orientation and practical advancement of the business model “time-delayed charging of electric cars with green electricity self-produced at home” is facilitated by continuous communication and ongoing exchange of information among all project partners. Thus, economic risks are significantly lowered since the project partners provide comprehensive information and ensure that the development process of the business models is transparent.

5 Project Support

The cooperative project “business models for electromobility with de-centrally produced green energy under the goal of low-carbon individual transport in middle-sized cities and rural areas (low-carbon city)” is supported by BMBF from August 1, 2016, to July, 31, 2018, under the reference 02K12A150 and 02K12A151 and supervised by the project owner Karlsruhe (KIT) [12].

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